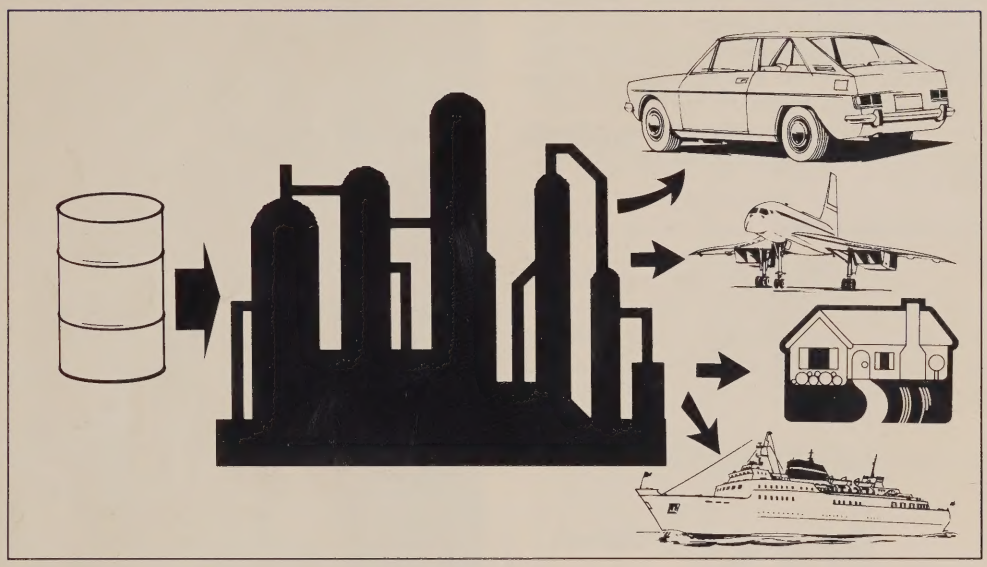
ONTARIO ENERGY FACTS

Petroleum Refining in Ontario

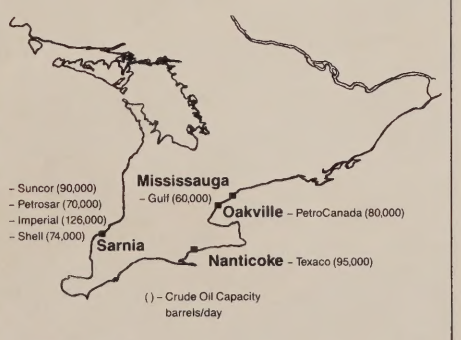


When a motorist pulls up to the gas station for $20 worth of gasoline, the last thing he thinks about is oil refining. However, crude oil requires complex treatment and processing before it is converted into useful products such as gasoline.

Refineries are the important middle link that transform crude oil into the many different petroleum products which our lifestyle demands. Ontario's refineries are sophisticated and highly automated manufacturing plants that make maximum use of the crude oil they receive.

Ontario has seven operating refineries, all of which are served by oil pipelines for crude oil delivery from Western Canada. These seven refineries have a total capacity to process approximately 600,000 barrels of crude oil per day – more than enough to supply the needs of the province for all refined petroleum products.

Ontario Petroleum Refineries*



*As of August 1, 1984

Ontario Ministry of Energy
Energy Ontario

Within the Refineries

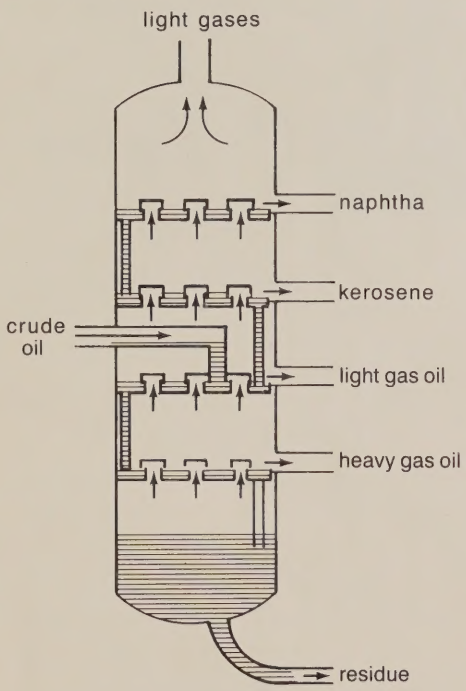
Each of Ontario's refineries follows the same basic crude oil refining process:

Separating►Converting►Product Blending

Separation

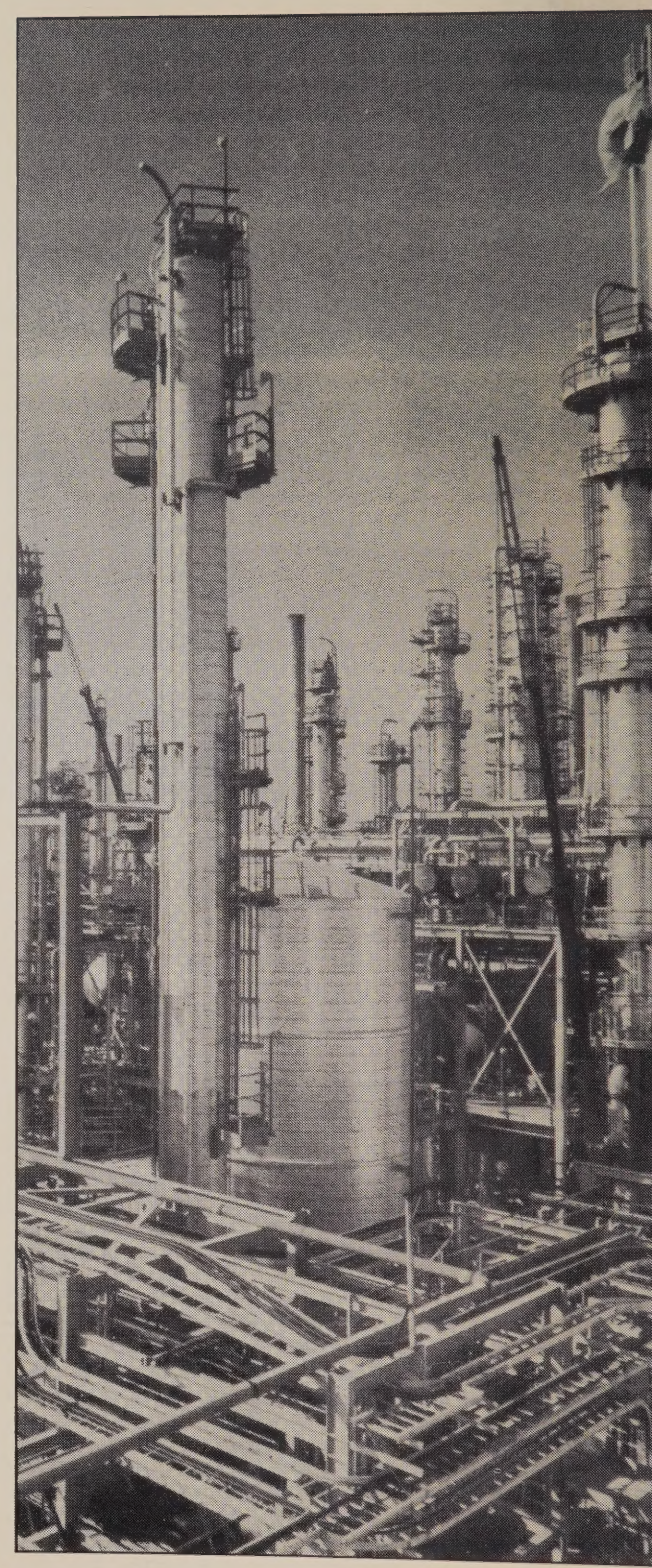
A process called "Atmospheric Crude Distillation" is used to separate crude oil into four main fractions: gases, light distillates, middle distillates, and residual products. These fractions have different boiling points depending on their chemical composition. Crude oil is boiled in a distillation tower which contains about 30 horizontal trays. Due to differing characteristics, the various fractions rise to different levels and are separated out.

Distillation Tower



The lightest components (gases), rise toward the top of the tower; heavier components (residual oils) settle to the bottom.

Gases taken from the top of the tower include methane, ethane, propane and butane. Light distillates, which are taken out part way down, are eventually made into motor gasoline for cars and airplanes, naphtha and kerosene. Middle distillates, re-



moved near the middle of the tower, are eventually turned into furnace fuel and diesel fuel.

Residual products left at the bottom of the tower are further refined in vacuum towers. Reduced pressure within these towers permits remaining heavy fractions to separate into vacuum gas oil and heavy products such as pitch without drastically increasing the temperature of the oil. Heavy oils are eventually converted into fuel for ships and industry and used in the generation of steam. Vacuum tower pitch is made into products such as paving asphalt.

Conversion

After the crude oil components are separated, a variety of processes are used to convert these crude oil fractions into useful products. Several forms of chemical conversion are used to physically change the structure of the crude oil components.

One major conversion process is called *"catalytic cracking"*. This process breaks down vacuum gas oils into gasoline blending stocks and light cycle oil used in blending furnace oil. A "catalyst" is used to accelerate the chemical conversion process. This is the most common method of producing high grade gasoline in Ontario.

Another major form of conversion used to produce high grade gasolines is called *"reforming"*. In this process a stream of light distillate called naphtha is heated in the presence of a catalyst and chemically reformed into high octane gasoline blending stock.

A process called *"alkylation"* is also used to produce gasoline. This process converts light fractions, released during reforming and catalytic cracking, into high octane gasoline blending stock.

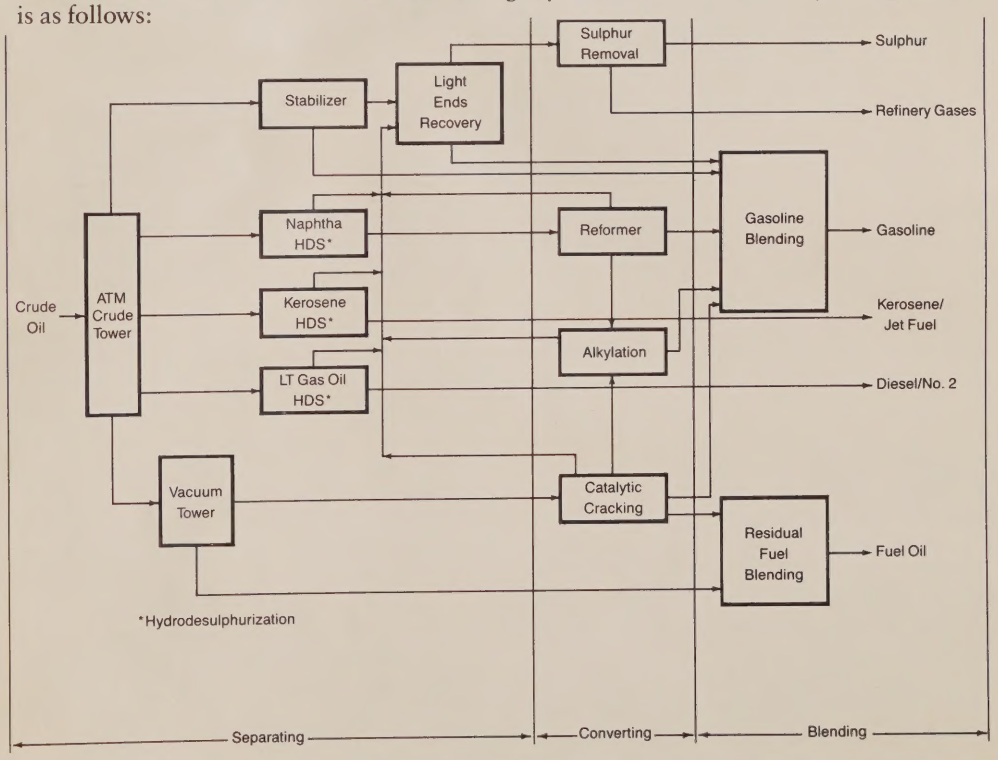
Product Blending

A wide range of consumer products is made by blending together various crude oil fractions which have been purified, separated, and converted. Various additives are also blended with the refined oil fractions.

A commonly produced product is motor gasoline. Each grade of gasoline must be produced to meet set octane levels. Octane is

Refinery Configurations

While each of Ontario's refineries is slightly different, a basic refinery configuration is as follows:



a measure of how well a gasoline will perform in an engine. Too low octane will cause engines to knock. Refiners meet required octane levels by blending various gasoline components, some of which have low natural octane and others which have higher natural octane. Lead based compounds are the most inexpensive additives used to increase the octane level of leaded gasoline.

Refinery Flexibility

Crude oils from different sources have varying properties and yield products in different proportions. Therefore, refineries must be flexible enough to process different crudes in response to changes in availability or in market demand. This flexibility requires expensive equipment and technology. Oil companies must be able to predict product prices and demand in order to select an appropriate configuration for their refineries.

Over time, conditions change. Demand for some products rises while that for others falls. The relative prices of different crudes change. More stringent environmental regulations may come into force. New technology may render existing units obsolete. All these factors result in the need for ongoing investment.

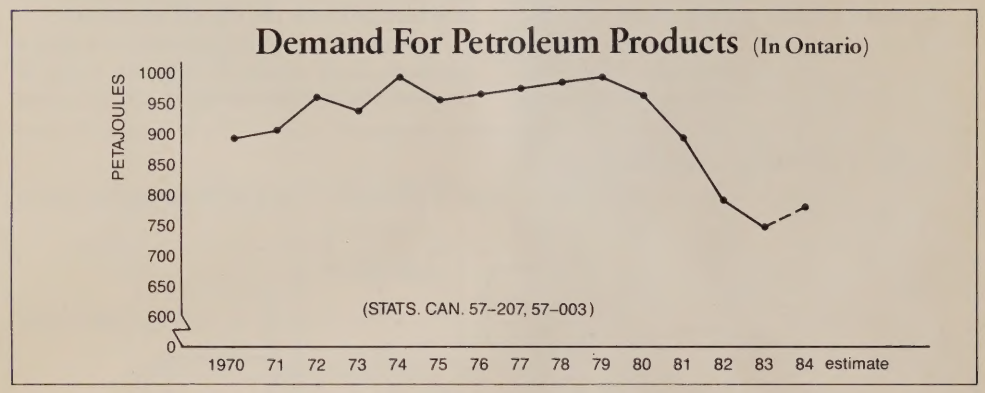
In the late 1960's and early 1970's when oil was relatively inexpensive, refinery production was increased to meet the constantly growing demand for petroleum products. In the mid-1970's, however, global events caused crude oil prices to skyrocket. Ontario consumers responded by drastically reducing their consumption of petroleum products.

Canadian refineries operated at 70% capacity in 1983 and were forced to make changes. Some older, less efficient refineries were closed. Others have been modified to operate efficiently at lower throughputs. Continued adjustment of production facilities will be necessary to maintain a stable marketplace by keeping production levels in line with demand.

Besides changes to meet fluctuations in total demand, refineries must be able to adjust to varying product requirements. For instance, in response to Federal regulations to reduce lead in gasoline, refiners are faced with the need to boost natural octane in the base gasoline stock before any additives are included. Some refiners may have to modify existing facilities or install new processes to increase natural octane for low lead gasoline. These modifications will cost significant amounts of money.

While natural octane levels can be increased by more severe processing, this would result in lower amounts of gasoline per barrel of crude oil. Additional crude would have to be processed to maintain production levels of gasoline as well as to provide the extra energy for refining. The alternative is to use chemical octane boosters which are currently more expensive than lead. Either option involves major costs and processing changes.

The changes required to reduce lead levels in gasoline typify how modern refineries require ongoing investment to meet ever changing market requirements.



For Additional Information
Please contact:

Enquiries Section
Ontario Ministry of Energy
56 Wellesley Street West
Toronto, Ontario
M7A 2B7
(416) 965-3246

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